Forest Service

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Subject: Dwarf Mistletoe Infection in CEEMS Certification Stand

To: Heather McRae, Forester, Tusayan RD

I recently met with you to assess your CEEMS certification stand for insect and disease activity. This letter describes our observations and provides technical information on the life history and management of insects and pathogens of concern and includes recommendations for your particular site.

Current Insect and Disease Activity

The 72 acre stand is dominated by approximately 80-90 year old ponderosa pine that is interspersed with groups of older yellow pines and Gambell oak. The only common insect or disease agent was dwarf mistletoe in ponderosa pine, which is distributed in pockets of low to moderately infected trees interspersed with disease free areas.

The stand exam survey, which quantified the incidence of dwarf mistletoe infection, supported our observations. During the survey, inventory trees were assigned dwarf mistletoe ratings (DMR) using Hawksworth's[i] 6-class system. This rating system divides the live crown of trees into thirds, and each third is rated separately as: 0, no mistletoe infection; 1, less than 50% of live branches infected; 2, more than 50% of live branches infected. The ratings for each third are totaled to obtain a DMR for each tree. A mean DMR for a site (stand) is calculated by adding the DMRs of all infected trees (greater than 1 inch diameter at breast height (DBH)), and dividing by the total number of trees, infected and uninfected. The stand average DMR for this site is 0.8; approximately 26% of ponderosa pine stems (again, >1" dbh) were found to be infected.

Treatment Options to Reduce Impact of Dwarf Mistletoe

Dwarf Mistletoe

Dwarf mistletoes are parasitic, seed-bearing plants that depend on their hosts almost completely for water and nutrients. They cause significant changes in physiological processes and structural characteristics of infected trees, which result in changes in the structure and function of forest communities[ii] [iii]. Dwarf mistletoe infection within a tree spreads slowly, but trees eventually experience growth loss, mortality, reduced seed production and viability, and a predisposition to bark beetles[iv] and root disease. Overall effects on forest structure in a site that has been infected for many generations include: increased stand openings; lower crown canopy; denser canopy due to witches' brooms; and fewer large diameter trees.

The direct and indirect effects of dwarf mistletoe infection on its host can provide forage and nesting habitat for many species of birds[v] and mammals[vi]. Although several bird species have

been observed feeding on mistletoe berries and shoots, there is little quantitative data on any except for blue grouse, which has been found to consume Douglas-fir dwarf mistletoe shoots in the fall. Insectivorous birds feed on insects that feed on the mistletoe and on bark beetles that attack weakened infected trees. Recent research measured positive, negative, and null correlations between mistletoe related variables (e.g., the amount of mistletoe on a site and snag density) and bird species abundance in ponderosa pine sites in northern Arizona[vii]. Of the 16 bird species investigated, a positive relationship was found for 4 species, negative correlation for 5 species, and no correlation for 7 species. Three of the 4 species that were positively correlated with dwarf mistletoe infestation or snag density were cavity-nesting birds. The only foliage nesting bird with a positive relationship was western tanager. Bennetts et al.[viii] found a positive correlation between mistletoe infection and 24 bird species; these Colorado study sites had a mixed-conifer and understory shrub component absent from the study sites in Arizona.

The focus of managing mistletoe is to reduce the impacts of mistletoe infection on forested sites. Mistletoe management is a continuous process; new dwarf mistletoe infections take 3- to 5-years (latent period) to produce aerial shoots and not all infection can be detected and removed during one treatment. At least one treatment will be needed 5 to 10 years after an initial treatment, but can be accomplished during regularly scheduled silvicultural or prescribed fire treatments.

Several features of dwarf mistletoes make them ideal candidates for cultural management[ix]:

- Dwarf mistletoes require a living host to survive. Mistletoe dies when an infected tree or branch is cut.
- Dwarf mistletoes are commonly restricted to a single host species or a group of closely related species. Non-host species can be favored during stand treatments.
- Dwarf mistletoes have fairly long life cycles and slow spread rates.
- Spread rates average only 1 foot per year. Although birds contribute to long-distance dispersal of seeds, this is rare and of little practical significance from a control perspective.
- Southwestern dwarf mistletoe-infected ponderosa pine trees are generally easy to detect due to the presence of yellow-orange shoots and witches' brooms. Trees in heavily infested stands show signs of short stature, decline, and mortality.

Managing dwarf mistletoe is difficult in stands under uneven-age management. Spread from overstory to understory trees, known as vertical spread, is rapid when seeds from infected overstory trees shower down onto younger trees. Tree-to-tree, or lateral, spread occurs among the young trees when newly infected trees in the understory begin to produce seed. Infection then progresses outward beyond the range of seeds produced from overstory trees. Researchers[x] [xi] measured the distance of infected seedlings from infected overstory trees at different time intervals. In 20-year-old trees, nearly all infection is found within 35 feet of infected overstory trees. In 50-year-old trees, lateral spread of dwarf mistletoe increased the rate to nearly 80 feet in open stands and 65 feet in dense stands.

If uneven-aged treatments are to be applied in dwarf mistletoe infected stands, such as when implementing goshawk guidelines, it is best to select lightly infected stands on high quality sites. Although the mere presence of dwarf mistletoe in a stand is not related to site quality, the

abundance and impacts of the pathogen on the host are strongly related to the quality of a site, soil type, and slope[xii]. The incidence of southwestern dwarf mistletoe can be higher on dry sites with gentle slopes.

The University of Montana in conjunction with the Bureau of Indian Affairs developed the following guidelines in managing ponderosa pine stands infected with southwestern dwarf mistletoe:

Condition	**Recommended Treatment Options**
Less than 15% of stems infected	Individual Tree Selection
15%-25% stems infected	Group selection, less than 2 acres
Greater than 25% stems infected	Even-aged treatment

The relationship between percent infected and average stand dwarf mistletoe ratings needs to be explored before the latter can be used to drive management guidelines.

In certain stands with low-level, patchy distributions of dwarf mistletoe infection, group selection can be used to decrease disease incidence and impacts. However, residual trees located on the edges of openings need to be mistletoe-free in order to allow disease-free regeneration to develop in the newly created openings. Since latent infections are likely along the edges of a mistletoe center, it is recommended to cut 30-40 feet beyond the edge of visible infection. Limitations on size of openings, and reserve tree requirements can hinder the success of group selection treatments in dwarf mistletoe infected stands. Followup surveys and treatments need to be conducted 5-10 years after group removals in order to check the perimeter for infected trees.

Prescribed burns can also be used to reduce dwarf mistletoe infection levels. Heavily infected trees have been shown to have reduced post-burn survival rates compared to lightly infected or non-infected trees[xiii xiv], and limbs located in the lower crowns of trees may be killed during fire. Since dwarf mistletoe infections are generally more abundant in the lower crowns of infected trees, infection levels are decreased when death of lower limbs occurs.

Recommendations

Dwarf mistletoes markedly affect the growth, form, and survival of infected trees. Treatments to mitigate mistletoe impacts can be integrated with other treatment activities like reducing a stands susceptibility to fire or insect outbreaks. Uneven-aged treatments should only be considered in non-dwarf mistletoe infected stands or lightly infected stands on good quality sites that have well defined infection patches in which group selection can be used to target the removal of infected trees. Increasing space between trees helps limit spread because seeds of dwarf mistletoe are explosively released and typically travel 10 to 40 feet from a fruit bearing plant. This reduces infection levels while still allowing trees to grow to maturity.

Even-aged treatments are recommended in moderately to heavily dwarf mistletoe infected stands while group selection can be used in moderately infected stands that are adequately stocked. In either case, target the more severely infected trees for removal while also emphasizing retaining

the most vigorously growing trees. Heavily infected stands should either receive a regeneration treatment, such as a shelterwood, or be deferred from treatment.

Regardless of the emphasis on even-aged or uneven-aged stands, proper selection and marking of leave trees is paramount to the success of treatment. In stands selected for group selection treatments it is important to attempt to remove trees with latent infections, as described above, cutting 30-40 feet beyond the edge of visible infection. In stands receiving individual tree selection treatments, leave trees should have none to very little mistletoe infection. Monitoring for followup treatments in 5 to 10 years is recommended.

Thinning slash may pose a short-term bark beetle risk to residual trees in thinning units or surrounding areas depending on: the timing of thinning; local populations of pine engraver beetles; and site and environmental factors such as site quality and precipitation. Our office recommends that slash be generated between late summer and the end of December, if possible, in order to lessen the buildup of ips bark beetles. Slash piles should be placed in stand openings as much as possible and the largest diameter slash put on the outside of the pile to promote quick drying. Tepee style slash piles with branches and small-diameter slash in the middle and the larger diameter material on the outside.

If you have any questions, please give me a call at (928) 556-2075.

/s/ Mary Lou Fairweather
MARY LOU FAIRWEATHER
Forest Pathologist, Forest Health, Arizona
Zone

cc: John Anhold

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